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## (54) Electromagnetic vibrators

(57) A head expander for attachment to the armature head 7 of an electromagnetic vibration generator is of generally frusto conical form and comprises an upper support plate or working platform 1 at its larger end and a lower plate 2 at its smaller end. A cellular structure 3 of honeycomb form extends between the plates 1 and 2 with the axis of the cells normal to the plane of the plates and a plurality of stiff walled load transmitting tubes 4 extend through the cellular structure parallel to the axis of the cells. The cellular structure 3 is of layered or sandwich form with each cellular layer separated from its adjacent layer or layers by a separator sheet 5. An outer side wall covering or skin 8 is provided to enclose the cellular structure 3. The head expander is generally frusto-conical in shape.

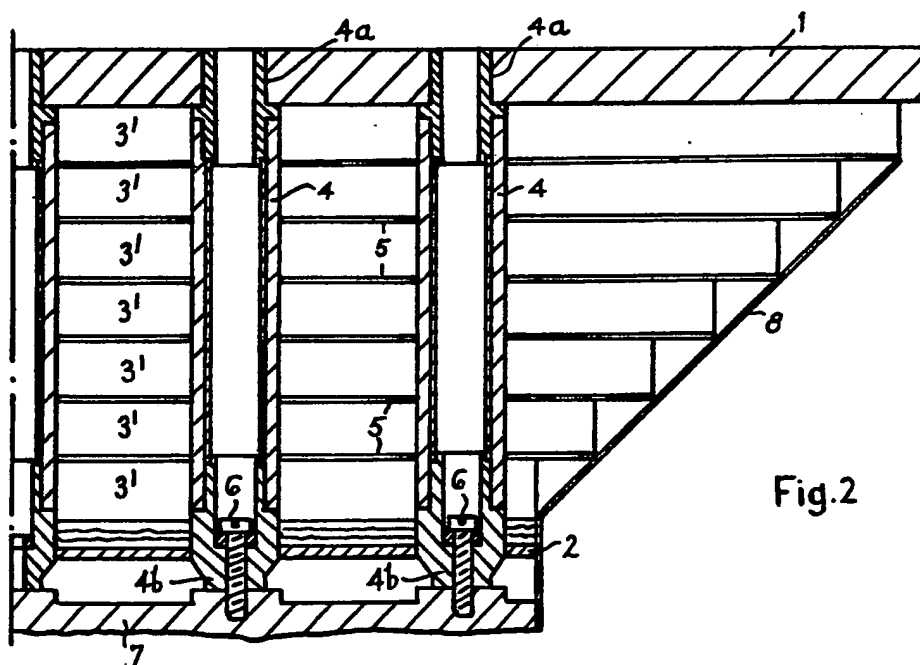


Fig.2

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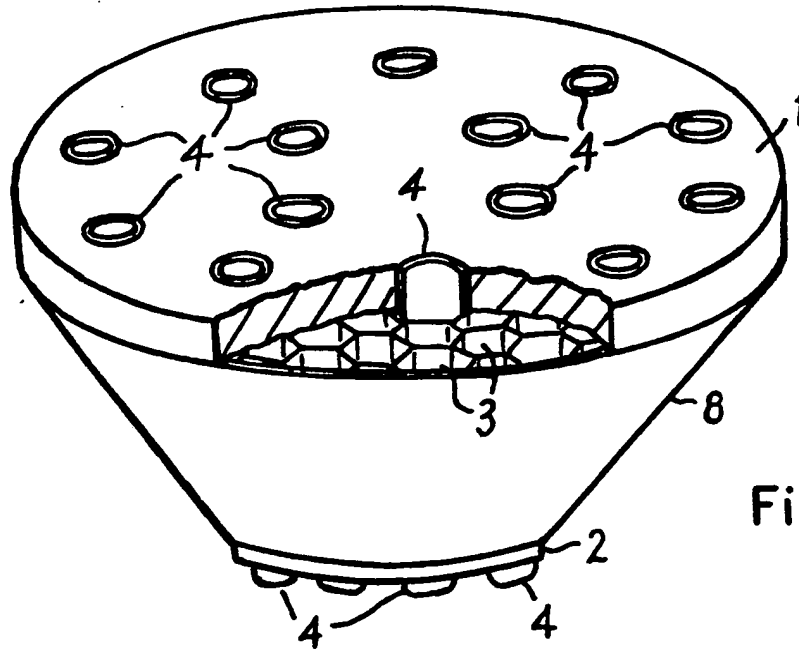


Fig. 1

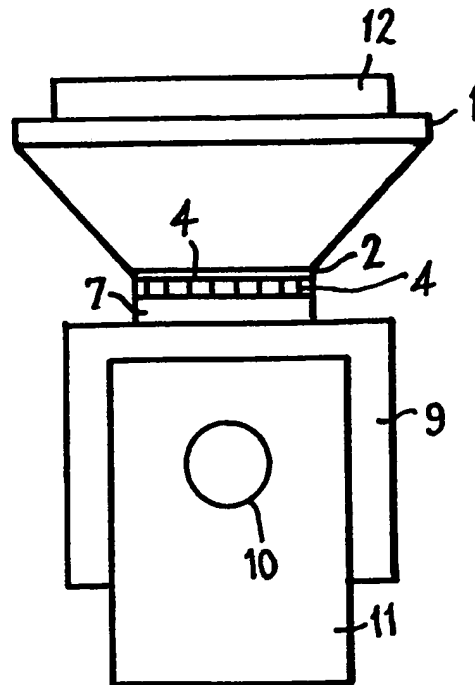
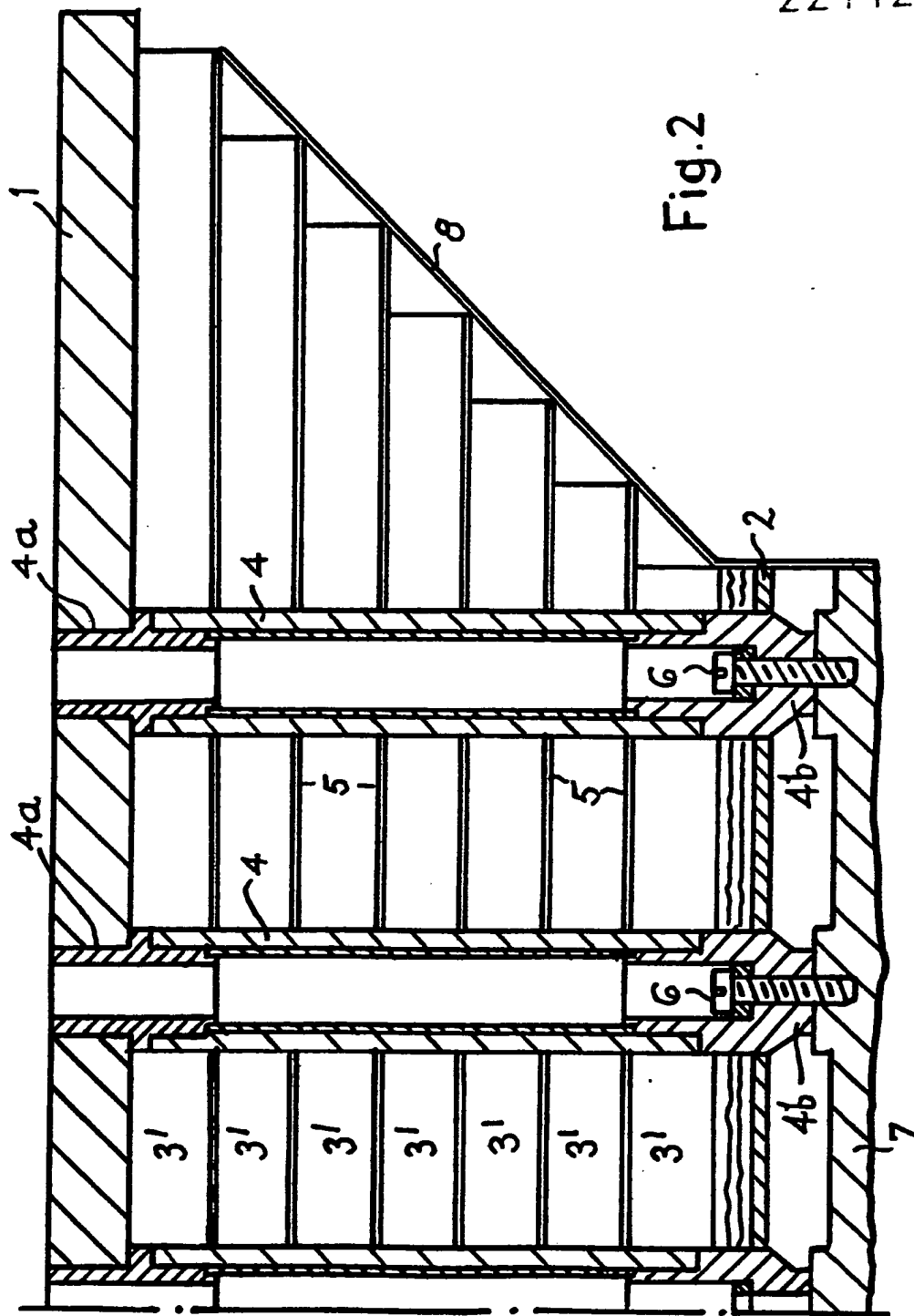


Fig. 3

Fig. 2



ELECTROMAGNETIC VIBRATORS

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The present invention relates to electromagnetic vibration generators otherwise known as "shakers" which produce a simulated vibration environment and are employed for the vibration testing of articles, such as components, devices and apparatus.

Such vibration generators basically consist of an armature structure including a coil which is suspended in an air gap of a magnetic circuit defined by the stator or body of the vibration generator.

10 Energisation of the armature coil at a selected frequency causes the armature structure to vibrate at that frequency and hence subject an article connected to or carried by the armature to such vibration.

In order that vibration testing can be carried out either along a vertical axis or a horizontal axis the vibrator body is generally mounted in trunnions so that it can be turned between a vertical and a horizontal position. For vibration testing along a horizontal axis the armature of the vibration generator is usually connected to a slip table or other support on which an article to be tested is secured.

For vibration testing along a vertical axis it is possible to support small articles directly on the head of the armature. However, since the actual area of the armature head is relatively small, it is known to fit an armature with a so-called head expander. This is a type of platform which rests on and is secured to the armature head in order to provide a greater support area to accommodate larger articles to be tested.

30 Existing constructions of head expander are cast

or fabricated solid metal structures and whilst providing the required increase in working surface area to support larger articles to be tested, they suffer from the disadvantage of having a significant mass  
5 which obviously detracts from the performance of the vibration generator.

It is an object of the present invention to provide an improved construction of head expander of lower mass which therefore requires less vibrator thrust to drive  
10 it.

According to the present invention a head expander for attachment to the armature head of an electromagnetic vibration generator comprises a cellular structure attached to a support surface for supporting  
15 an article to be tested, said cellular structure being such as to provide structural stiffness between the armature head and the support surface.

According to one form of the invention the cellular structure is of a generally honeycomb form with  
20 the cells disposed normal to the support surface so that they extend vertically when the head expander is in operative position attached to an armature.

Alternatively, instead of being a honeycomb, the cellular structure could be grill-like, for example  
25 the cells could be rectangular in cross-section.

According to a preferred form of the invention, a plurality of stiff walled tubes extend through the cellular structure parallel to the axis of the cells and serve to transmit load from the vibrator to the  
30 support surface. These tubes also provide locations

for receiving screws or bolts by means of which the head expander is attached to the armature head.

The cellular structure may be layered, i.e. of sandwich form with separator sheets disposed parallel to the support surface and separating adjacent layers of the cellular structure.

In one preferred embodiment of the invention, the head expander is of generally frusto conical form with the larger end forming the support surface or working platform on which an article to be tested is secured and the smaller end adapted to fit on the armature head of the vibrator.

The invention will now be further described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a perspective view, having a part cut away, of one embodiment of head expander according to the invention,

Figure 2 is a one-half sectional view on a larger scale showing the construction of the head expander in greater detail, and

Figure 3 is a diagrammatic view showing the head expander attached to an electromagnetic vibration generator.

Referring to the drawings, the head expander illustrated is of generally frusto conical form and comprises an upper support plate or working platform 1 at its larger end and a lower plate 2 at its smaller end. A cellular structure 3 of honeycomb form extends between the plates 1 and 2 with the axis of the cells normal to

the plane of the plates and a plurality of stiff walled load transmitting tubes 4 extend through the cellular structure parallel to the axis of the cells.

The structure is shown in greater detail in Figure 2 which illustrates that the cellular structure 3 is of layered or sandwich form with each cellular layer 3' separated from its adjacent layer or layers by a separator sheet 5. The load transmitting tubes 4 are located at their upper end 4a and lower end 4b respectively in the upper support plate 1 and the lower plate 2 and also serve as locations for bolts or screws 6 by which the head expander is attached to the armature head 7. An outer side wall covering or skin 8 is provided to enclose the cellular structure 3.

Figure 3 illustrates the head expander attached to the armature head 7 of an electromagnetic vibration generator having its stator or body 9 mounted on trunnions 10 in a supporting frame 11. As shown the vibration generator is oriented for vibration along a vertical axis in order to transmit vibrations to an article 12 secured to the horizontally disposed working platform 1.

In the embodiment described, the plates 1 and 2 and the cellular structure 3 are preferably made of aluminium or an aluminium alloy whilst the load transmitting tubes 4 are preferably carbon fibre tubes.

The head expander is constructed by forming the sandwich of cellular layers 3' and separator plates 5 which is then cut to frusto conical form. The holes to receive the carbon fibre tubes 4 are then machined and

the tubes and honeycomb sandwich are assembled on to the aluminium top plate 1 and bottom plate 2 together with an epoxy resin adhesive at the interfaces of tubes, honeycomb and plates. The assembly is then cured at the  
5 required temperature and under vacuum. Finally the aluminium skin 8 is bonded to the structure.

If desired, the head expander could also be constructed of different materials. For example, the cellular structure could be of steel, polyamide or glass fiber  
10 and the working platform 1 could be of a resin bonded cloth or fibre glass. As regards the load transmitting tubes 4, these could alternatively be of steel or aluminium, although carbon fibre is preferred for its better stiffness to weight ratio.

15 It will also be understood that various alternative forms of structure may be devised within the scope of the invention. For example the cellular structure need not be formed as a sandwich. Moreover various forms of grid like arrangement may be employed instead of a  
20 honeycomb structure. It will also be apparent that the overall shape of the structure may be other than frusto conical.



CLAIMS

1. A head expander for attachment to the armature head of an electromagnetic vibration generator comprising a cellular structure attached to a support surface for supporting an article to be tested, said cellular  
5 structure being such as to provide structural stiffness between the armature head and the support surface.
2. A head expander as claimed in claim 1, wherein the cellular structure is of a generally honeycomb form with the cells disposed normal to the support  
10 surface so that they extend vertically when the head expander is in operative position attached to an armature.
3. A head expander as claimed in claim 1, wherein the cellular structure is grill-like.
4. A head expander as claimed in claim 3, wherein  
15 the cells are rectangular in cross-section.
5. A head expander as claimed in any preceding claim, wherein a plurality of stiff walled tubes extend through the cellular structure parallel to the axis of the cells and serve to transmit load from the vibration  
20 generator to the support surface.
6. A head expander as claimed in claim 5, wherein the tubes provide locations for receiving screws or bolts by means of which the head expander is attached to the armature head.
7. A head expander as claimed in any preceding claim,  
25 wherein the cellular structure is layered with separator sheets disposed parallel to the support surface and separating adjacent layers of the cellular structure.
8. A head expander as claimed in any preceding claim,  
30 wherein the cellular structure is enclosed by an outer side wall covering or skin.

9. A head expander as claimed in any preceding claim, wherein the cellular structure is made of aluminium or an aluminium alloy.
- 5 10. A head expander as claimed in any one of claims 5 to 9, wherein the stiff walled tubes are made of carbon fibre.
- 10 11. A head expander as claimed in any preceding claim, which is of generally frusto conical form with the larger end forming the support surface or working platform on which an article to be tested is secured and the smaller end adapted to fit on the armature head of the vibration generator.
- 15 12. A head expander for attachment to the armature head of an electromagnetic vibration generator substantially as herein described with reference to the accompanying drawings.
- 20 13. An electromagnetic vibration generator including an armature head having a head expander, as claimed in any preceding claim, attached thereto.
14. An electromagnetic vibration generator substantially as herein described with reference to the accompanying drawings.